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# **Learning by cases in food technology**

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## **ABSTRACT**

The purpose of this paper is to evaluate the use of the method learning by cases for teaching food technology students at the technical university of Denmark (DTU) and to clarify if the method can be used to improve the motivation and make the students more active and thereby be more in control of their own learning process, to feel more secure and less frustrated.

The applying of the learning by cases method at the food technology course can make the students to learn in a significantly way, where they will be more actively involved in the learning process than previous. The work with real life cases with engineering topics, can develop the students knowledge and understanding, which gives the students a more conceptual understanding of engineering tasks, and can improve their skills to analyze and deal with complex situations and furthermore to be more confident with the course curriculum.

*Keywords* – cases, dialogue in class, discussion-based learning, learning by cases

## **I. Introduction**

The basic principle behind the theory of learning styles is that different people learn in different ways. To gain a satisfied learning outcome it is important to achieve a good learning process by motivate and make the student more activate and thereby let them take responsibility and more control over their own learning development. The learning process is a lot more enjoyable if the students are convinced that what they are learning and the way of learning makes sense (Mauffette-Leenders et al., 1999). This paper addresses the use of the learning by cases – a discussion based learning method adopted for teaching of students in the food technology course at the Technical University of Denmark (DTU).

## **II. Purpose and background**

The purpose of this paper is to evaluate the potential use of the method learning by cases for teaching food technology students at the Technical University of Denmark and to clarify if the method can be used to improve the motivation and make the students activate to be more in control of their own learning process and thereby make them feel more secure and less frustrated about the course curriculum.

### **Introduction to the course**

The food technology course is a major and mandatory course for students studying the food science bachelor programme. The course is a theme part of the food science education conducted in cooperation between Copenhagen University (KU) and Technical University of Denmark (DTU). The two universities have different teaching cultures, which the students in the course have to cope with. The major focus of the course is in general to apply the students with engineering competences in the field of food science. The course deals with non-stationary heat transfer, continuous and batch heat processing, membrane processing, salting, freezing and drying as well as microbial ecology in foods, food preservation and product quality. The course runs for 13 weeks with 16 hours per week and gives 15 ECTS points. The course consists of theoretical lectures (first part) and experimental work in pilot plan combined with a writing a report (second part). Traditionally the theory modules have been structured in the way that first the theory was introduced by the teacher and subsequently used in calculation exercises by the students.

Previously it has been observed that many of the students had difficulties in the last exam because of the course logistics, where the latter part leading up to the exam was mainly based on experimental work and reporting. Furthermore the students had a craving for more theory based teaching in the latter part of the course, more aligned with the exam-form.

When the students are attending the food technology course, it is the first time they work with engineering subjects, which requires a conceptual understanding of process variables and units. It has been observed that some of the students had difficulties with this and combined with other matters like the course structure and a new student environment (compared with what the students are used to), the students can become insecure and then have difficulties in seeing the meaning of the course.

There are several challenges in the course to be handled. One of the challenges is getting the students involved in understanding a new field, food technology and make them believe that the study of food technology is enjoyable, interesting and that it can be a positive step to a future career. Furthermore the students need to understand that learning is their own responsibility and recognize that good results will and should depend on the invested effort.

Several things have been done to optimize the course plan like including a case study to brush up the course theory in later part of the course. Furthermore an excursion to a production plan has been included giving the students a chance to see a real life production plan. For the experimental part more specific and detailed descriptions of the experimental exercises have been designed, which has made it possible to acquire an additional extra day for theory teaching in the latter part of the course.

Besides these changes, we would like to promote a deeper learning process. Therefore we would like to replace the traditional lecture teaching method by including active learning methods to create some variation in the teaching methods, as it is known that the learning process can be strengthened by variation.

### **Achievement of deep and active learning**

When planning a course the focus should be on student learning. The learning activities and teaching sessions are meant to support the students to obtain the overall learning objective. Students need to be aware of that learning is their own responsibility and that success depends on their own efforts and that they need to believe that even when things look difficult they can work things out for themselves and that invested effort will be rewarded by success.

Deep and surface learning are two approaches to study and they are not attributes of individuals as one person may use both approaches at different times. Deep approach to learning are when students are aiming towards understanding and surface approach to learning are when they are aiming to reproduce materials in test or exam rather than actually understand it. Deep learning involves the critical analysis of new ideas, linking them to already known concepts and principles, which leads to understanding and long-term retention of concepts so that they can be used for problem solving in new situations (Ramsden, 1992; Biggs & Tang, 2007).

The Kolb's learning cycle is well-known and the basis for the active learning principles. The learning cycle comprises of four stages of learning from experience and is concrete experiences, observation and reflection, abstract conceptualisation and testing concepts in new situations. The cycle is a continuous process with the current concrete experience being the basis for observations and reflections, which allow the development of a theory. The theory can then be tested in new situations to lead to more concrete experiences. Kolb says that ideally this process represents a learning cycle or spiral where the learner touches all the bases i.e. a cycle of experiencing, reflecting, thinking and acting (<http://www.businessballs.com/kolblearningstyles.htm>).

Several different methods for longer teaching sessions/courses exist like problem-based learning, project-based, learning by inquiry, learning by cases and several more. In this paper the focus is on the method learning by cases.

In the food technology course we would like the students to achieve a deep understanding of the principles in food processing and to be able to use known knowledge on new problems, new facts and thereby be able to analyze them critically, tying them into existing structures and make connection to other processes. They should be able to link the course content to real life. Therefore we have decided to include the active learning method learning by cases for some of the lectures.

### **Description of the Learning by cases method**

The casebased method is a well-established instructional tool and has been described in several papers (Camill, 2006; Galluci, 2006; Herreid, 2005 & Noblitt et al., 2010). In the case based approach the students are provided with a case study which is related to real life and it forms the basis for the study. A case is a description of an actual situation, commonly involving a decision, a challenge, an opportunity, a problem or an issue faced by a person in an organisation (Mauffette-Leenders et al., 1999). Cases enable the students to learn by doing and by teaching others. Furthermore cases are also an excellent tool to test the understanding of theory and to connect theory with application (Mauffette-Leenders et al., 1999).

The case based method has been used in disciplines like business, medicine and law; however it is a relatively new educational technique in the sciences. The case based technique was introduced to the sciences in the late 1990s by Clyde Freeman Herreid, and it was proposed as a way to teach science in a manner that creates control of content in connection with analytical skills. The case based method has been used by some instructors in pharmacy education for many years with success (Brown et al., 2011). Furthermore the method more closely mimics behaviours used by scientific researchers by putting students into teams to confront and solve problems (Epling et al., 2003). The cases studies are more effective in promoting improved critical thinking and communication skills, such as oral communication, compared to traditional instructor centred teaching (Noblitt et al., 2010). Teaching with cases is a very suitable method to use when lectures are the main teaching form in a course.

The procedure for learning by cases is a three-stage learning process. The students work with small problems/cases in a structured way and this contribute to make them activate. The cases cover the topic of the lectures and are related to real life problems for the students to solve or to suggest solutions to. The students make use of their own knowledge in the field of subject and work actively with the present course topic. Several issues have to be considered making a case especially when designing a case for the first time. One major issue is what do we want the students to learn and how can we use the case to help the student gain this knowledge?

The case learning process is basically composed of three major stages:

1. Individual preparation
2. Small group discussion
3. Large group or class discussion

Each of the three steps is important to create effective learning process and each contributes in different ways to maximizing the quantity and quality of learning (Mauffette-Leenders et al., 1999).

In the individual preparation stage, the students are given a case to read and analyze as preparation for the class. They are also urged to suggest solutions to solve the problem. It might be a good idea to give the students some guidance about how to initiate the process, when they are to do case-stories for the first time.

The next stage is the small group discussions, where the students are divided into smaller groups of 2 to 4 students. The small group discussion is an opportunity for the student to discuss her or his insights to the case. In the small groups the students should sum up their knowledge and discuss their suggested solutions to the case problem. Each group should then come up with some suggestions for solving the case. When

the students do case work for the first time, it can be a good idea to give some guidance for example how to lead a small group discussion and how to approach the case problem.

The final step in the three stage case learning process is a large group or a class room discussion. This is the last chance to create a thorough understanding of the case and to make an optimal resolution of the issue or decision. The discussions in class can ease the students understanding of the general theory behind the case. Besides this the class room discussion also give the students the opportunity to practice oral communication in the large group, to share their individual and small group learning with others and also to be evaluated by peers and teachers (Mauffette-Leenders et al., 1999). The large group or class room discussion is a sum up of the different conclusions from the students lead by the teacher. Using the method learning by cases it is very important that the teacher sums up the conclusions in the end of the session. Most likely there have been many discussions and suggestions from the different groups, and it is therefore very important that the loose ends are tied together.

The construction and formulation of the cases are very important. A well-defined case must cover the topics of the lecture and it must provide a suitable challenge for the students. The case can be related to a real life problem which the student can rely too. However some facts may be changed to simplify the scenario. The case can also be a constructed case which the student work with and discuss. Effective case assignments typically provide real life artifacts like supporting data and documents for the students to analyze. Many case assignments are open-ended problem which requires that the students can answer or develop solutions which are multiple solutions. When construction a case it is important to decide what we expect our students to learn (Gallucci, 2006). The problem should be described in a clear and precise way so it cannot be misunderstood by the students.

The use of a case discussion requires more effort from both the students and the teacher compared with traditional methods of teaching. With repeated expose to cases the students improve their skill in analyzing and dealing with ambiguous situations and incomplete information. They begin to learn how to approach problems in a focused and confident way that leads to firm, well-reasoned conclusions. The power of the case method lies in the active participation of the students. Furthermore the students improve their oral communication skills (Noblitt et al., 2010).

In Table 1 the different roles at a case-based learning session are described.

**Table 1. The different roles at case based learning**

Teacher role	To be an expert and a facilitator of the class discussion
Groups	Small groups of 2-4 students
Cases	Very short and adapted to the structure of the course.
	Typically one case per lecture
	Related to a real-life problem
	Well-defined with a lot of data but open-ended problem
Students	Learn to deal with complex problems and to take actively part in the learning process

### III. Methodology to be used in food technology

To make the students more activate and to establish a more dialogue based learning in the food technology course the learning by cases methodology will be introduced in the theoretical part in the next semester 2012. One of the topics in the food technology course curriculum is salting and the different salting techniques. The objectives are that the student should obtain knowledge with regards to mechanism of salting, calculation of salt concentration, the most common salting methods and which considerations should be done to obtain a safe product. Salting of salmon is a very important step in the smoking process of salmon to avoid bacterial growth and to control pathogen bacteria like *Clostridium botulium*. Several methods for salting of salmon can be used, and the method of salting affects the quality and shelf life of cold-smoked salmon. The salting process of salmon is a good way to demonstrate different salting methods and their effects on safety and product quality, and furthermore cold-smoked salmon is a well-known product which the student can relate to from their everyday life. Thus a case concerning salting of salmon for producing cold-smoked salmon has been constructed, and it will be tried out in practice in autumn 2012.

#### Construction the case

The case about salting of salmon is constructed in that way that the students need to acquaint oneself with the different salting methods. The student in the food technology course had previous been taught food microbiology and they are expected to use this prerequisite to evaluate the safety aspects. However they had not previously been asked to combine this knowledge with aspects of processing. A flow sheet for a general production of cold-smoked salmon is handed out, but they will need to find some additional information with regards to salmon. The solution to the case is open-ended as there are several possibilities for salting of salmon. The different solutions will lead different qualities of the final product. Thus the students can see how a decision will have impact on the final quality for the consumer. The description of case is shown in Table 2, and it is a short and precise description of the case problem with some questions which the student has to reflect on.

**Table 2. The case description**

<b>The Case: Salting of salmon for production of cold-smoked salmon</b>
<p>You are employed in a fish company, and the company are going to produce cold-smoked salmon as a new product. It is your responsibility to investigate the different possibilities for salting the raw salmon and to evaluate which effects the methods will have on the final product with regards to safety and quality. The salmon are bought rinsed and filleted, and are ready for salting when they arrive at the company.</p> <ul style="list-style-type: none"><li>• Consider which salting methods can be used and describe the pros and con for each of the methods.</li><li>• Which level of salt should be aimed at (after salting is finished) and why this level should be discussed</li><li>• Consider the time for salting (per fillet) and explain why this time frame is chosen.</li><li>• Consider the influence on the final quality for the chosen salting method.</li></ul>

On previous lecture the case is introduced by the teacher and the case description and the flow sheet for the production of cold-smoked salmon are handed out to the students.

### **Individual preparation**

Before coming to the lecture, the students are expected to do some individual preparations. In the course material the students can read about general salting techniques, but they need to find some additional literature about salting of salmon and which methods are generally used. They should include their prerequisites about relevant microbiology and which precautions they need to take to avoid growth of bacteria.

### **Small group discussion in class**

The session in class starts with a short introduction done by the teacher about the topic. Afterwards the students are divided up into groups of 2 to 4 students. The groups will then have about 30 minutes to discuss the different solutions and to share their knowledge within the group. Each group has to suggest only one solution for salting of salmon and explain why they have chosen that one and which benefits and complications there could be for that method.

Some guidelines for the small group discussion include that each student should participate actively in the discussion and each student should be well-prepared. It is not important that the group achieve consensus, but they should suggest one solution to salt salmon and explain why this method was chosen. A challenging task could be that some of the students have not done the individual preparation or that some of the students are not actively participating in the discussion. One way to avoid these problems could be to have a presentation before the case work about why it is important that all are well-prepared and actively participate to obtain a high outcome.

### **Large group discussion**

After the small group discussion the students are gathered together for the class room discussion for about one hour, where the different solutions to the case problem are discussed. The class room discussion is lead by the teacher. One group (by turn) will present their solution to the case. Next step is to ask each group to explain why they have suggested this solution and which assumptions there are behind. Probably the different groups will suggest different solutions and pros and cons of each solution should be discussed. At the end of the session, the teacher sums up on the solutions and give a description of how the different salting methods are used and which influence the salting method have on the quality of the final product and the safety.

The final part of the session will be a short outline done by the teacher of the other aspects of salting which has not been included in the case work, so the topic has been covered. In that way the students should have obtain a broad overview of the mechanism of salting, the most common salting methods and which considerations should be done to obtain a safe product.

We expect that the use of the method learning by case in the food technology course, will make the students more actively involved in the learning process as they have to come up with some solutions to solve case problems and furthermore to participate actively in the group discussions. It is expected that the students learn from each other as well as from their own experience dealing with case problems. The discussions in class can ease the students understanding of the general theory. The work with real life cases with engineering topics, develop the students knowledge and understanding, which gives the students a more conceptual understanding of engineering tasks and improve their skills to analyze and deal with complex situations.



However there can be several challenges when implementing a new learning method. One thing could be that not all the students think that working with cases is a good learning method. Mostly because they are not used to work with cases and some students may be uncomfortable with open-ended questions as well as working in groups. Another thing could be the time limits and that students do not have enough time to do a proper preparation.

It can also be a challenge to construct the case and do the whole process for the teacher. Probably it will be difficult to reach the proper level which is not too low or not too high for the students the first time a case is constructed.

To avoid these pitfalls, a good introduction to the case work is necessary and after the case work, the process should be reviewed with the students, so it can be improved in a retrospective session.

So far one case about salting has been constructed and it will be implemented in the food technology course in autumn 2012. Depending on the student's reaction to the method and how the student's performance are improved, more cases will be constructed on other topics in the course.

#### **IV. Conclusion/perspectives**

In the food technology course there are several challenges to attack. Some of the challenges have been handled by changing the structure of the course and by making more detailed descriptions of the experimental work. However there is still a need for further improvement in order for the students to achieve a deep understanding of the principles in the food processing and to be able to use the knowledge on new cases.

By applying learning by cases at the food technology, the students are expected to be more actively involved in the learning process than previous. The aim is that the students will become more confident about the course and more in self control of the learning process and thereby will be less frustrated and have a good learning process.

The work with real life cases with engineering topics, is expected to develop the students knowledge and understanding, which gives the students a more conceptual understanding of engineering tasks and improve their skills to analyze and deal with complex situations and to be more confident with the course curriculum.

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## **BIOGRAPHICAL INFORMATION**

Hanne Løje is an assistant professor at National Food Institute at the Technical University of Denmark, Lyngby, Denmark. She is involved in teaching and research within the food area. Her interests are focused on learning methods, and educational developments. Besides this her research area is food technology with emphasis on technology parameters of meal components for the food service.